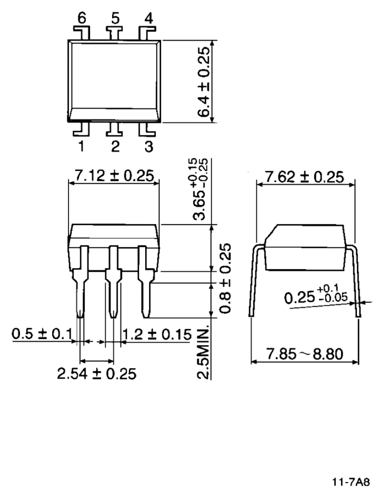
TOSHIBA Photocoupler GaAs IRed & Photo−Transistor

# TLP630

Programmable Controllers
AC / DC−Input Module
Telecommunication

Unit in mm



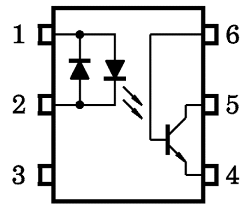

TOSHIBA 11−7A8

Weight: 0.4g

The TOSHIBA TLP630 consists of a photo−transistor optically coupled to two gallium arsenide infrared emitting diode connected inverse parallel in a six lead plastic DIP package.

- Collector−emitter voltage: 55V min.
- Current transfer ratio: 50% min.
  Rank GB: 100% min.
- Isolation voltage: 5000Vrms min.
- UL recognized: UL1577 file no. E67349

## Pin Configurations(top view)




1 : ANODE, CATHODE
2 : CATHODE, ANODE
3 : N.C.
4 : EMITTER
5 : COLLECTOR
6 : BASE

## Absolute Maximum Ratings (Ta = 25°C)

| | Characteristic | Symbol | Rating | Unit |
|---|---|---|---|---|
| LED | Forward current | $I_{F(RMS)}$ | 60 | mA |
| | Forward current derating (Ta ≥ 39°C) | $\Delta I_F$ / °C | −0.7 | mA / °C |
| Detector | Peak forward current (100μs pulse,100pps) | $I_{FPT}$ | ±1 | A |
| | Collector−emitter voltage | $V_{CEO}$ | 55 | V |
| | Collector−base voltage | $V_{CBO}$ | 80 | V |
| | Emitter−collector voltage | $V_{ECO}$ | 7 | V |
| | Emitter−base voltage | $V_{EBO}$ | 7 | V |
| | Collector current | $I_C$ | 50 | mA |
| | Power dissipation | $P_C$ | 150 | mW |
| | Power dissipation derating (Ta ≥ 25°C) | $\Delta P_C$ / °C | −1.5 | mW / °C |
| Operating temperature range | | $T_{opr}$ | −55~100 | °C |
| Storage temperature range | | $T_{stg}$ | −55~125 | °C |
| Lead soldering temperature | | $T_{sol}$ | 260(10s) | °C |
| Junction temperature | | $T_j$ | 125 | °C |
| Total package power dissipation | | $P_T$ | 250 | mW |
| Total package power dissipation derating | | $\Delta P_T$ / °C | −2.5 | mW / °C |
| Isolation voltage (AC, 1 min., R.H. ≤ 60%) | | $BV_S$ | 5000 | Vrms |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## Recommended Operating Conditions

| Characteristic | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | — | 5 | 24 | V |
| Forward current | $I_{F(RMS)}$ | — | 16 | 25 | mA |
| Collector current | $I_C$ | — | 1 | 10 | mA |
| Operating temperature | $T_{opr}$ | −25 | — | 85 | °C |

Note: Recommended operating conditions are given as a design guideline to obtain expected performance of the device. Additionally, each item is an independent guideline respectively. In developing designs using this product, please confirm specified characteristics shown in this document.

## Individual Electrical Characteristics (Ta = 25°C)

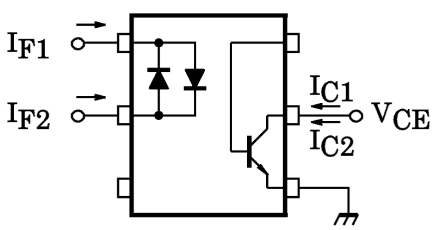
| | Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| LED | Forward voltage | $V_F$ | $I_F$ = 10mA | 1.0 | 1.15 | 1.3 | V |
| | Forward current | $I_F$ | $V_F$ = 0.7V | — | 2.5 | 10 | μA |
| | Capacitance | $C_T$ | V = 0, f = 1MHz | — | 60 | — | pF |
| Detector | Collector–emitter breakdown voltage | $V_{(BR)CEO}$ | $I_C$ = 0.5mA | 55 | — | — | V |
| | Emitter–collector breakdown voltage | $V_{(BR)ECO}$ | $I_E$ = 0.1mA | 7 | — | — | V |
| | Collector–base breakdown voltage | $V_{(BR)CBO}$ | $I_C$ = 0.1mA | 80 | — | — | V |
| | Emitter–base breakdown voltage | $V_{(BR)EBO}$ | $I_E$ = 0.1mA | 7 | — | — | V |
| | Collector dark current | $I_D(I_{CEO})$ | $V_{CE}$ = 24V | — | 10 | 100 | nA |
| | | | $V_{CE}$ = 24V, Ta = 85°C | — | 2 | 50 | μA |
| | Collector dark current | $I_{CBO}$ | $V_{CB}$ = 10V | — | 0.1 | — | nA |
| | Capacitance (collector to emitter) | $C_{CE}$ | V = 0, f = 1MHz | — | 10 | — | pF |

## Coupled Electrical Characteristics (Ta = 25°C)

| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Current transfer ratio | $I_C / I_F$ | $I_F$ = ±5mA, $V_{CE}$ = 5V | 50 | — | 600 | % |
| | | Rank GB | 100 | — | 600 | |
| Saturated CTR | $I_C / I_{F(sat)}$ | $I_F$ = ±1mA, $V_{CE}$ = 0.4V | — | 60 | — | % |
| | | Rank GB | 30 | — | — | |
| Base photo–current | $I_{PB}$ | $I_F$ = ±5mA, $V_{CB}$ = 5V | — | 10 | — | μA |
| Collector–emitter saturation voltage | $V_{CE(sat)}$ | $I_C$ = 2.4mA, $I_F$ = ±8mA | — | — | 0.4 | V |
| Off–state collector current | $I_{C(off)}$ | $V_F$ = ±0.7V, $V_{CE}$ = 24V | — | 1 | 10 | μA |
| CTR symmetry | $I_{C(ratio)}$ | $I_C(I_F = -5mA) / I_C(I_F = +5mA)$ (Note 1) | 0.33 | 1 | 3 | — |

(Note 1)

$$I_{C(ratio)} = \frac{I_{C2}(I_F = I_{F2},\ V_{CE} = 5V)}{I_{C1}(I_F = I_{F1},\ V_{CE} = 5V)}$$



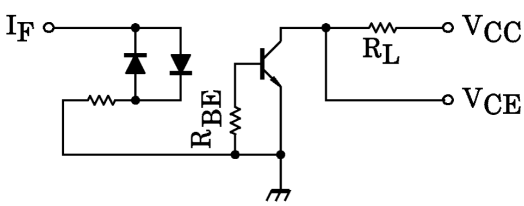
## Isolation Characteristics (Ta = 25°C)

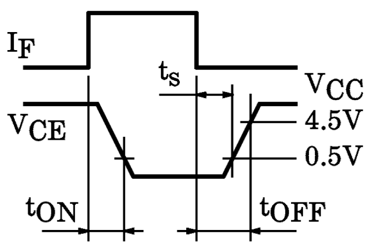
| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Capacitance (input to output) | $C_S$ | $V_S$ = 0, f = 1MHz | — | 0.8 | — | pF |
| Isolation resistance | $R_S$ | $V_S$ = 500V, R.H. ≤ 60% | $5\times10^{10}$ | $10^{14}$ | — | Ω |
| Isolation voltage | $BV_S$ | AC, 1 minute | 5000 | — | — | Vrms |
| | | AC, 1 second, in oil | — | 10000 | — | |
| | | DC, 1 minute, in oil | — | 10000 | — | Vdc |

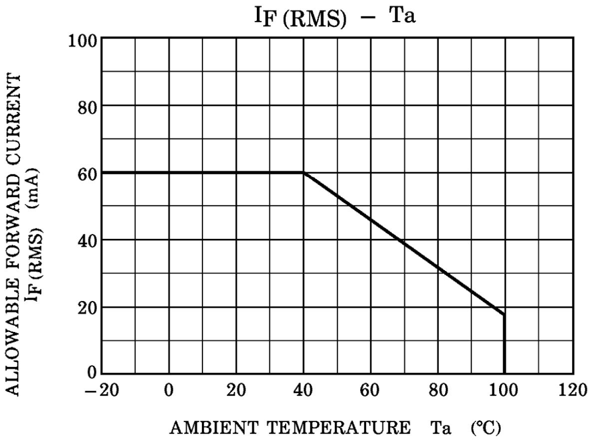
## Switching Characteristics (Ta = 25°C)

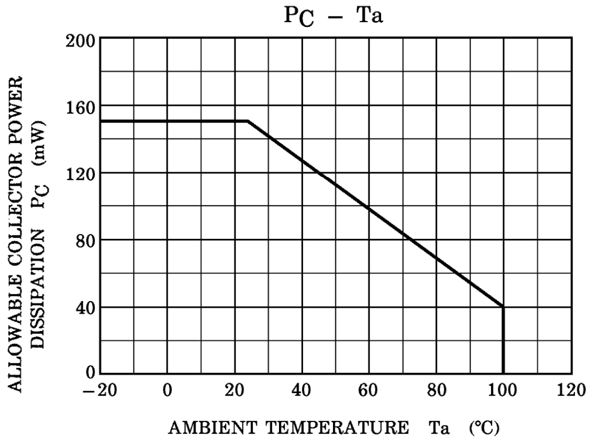
| Characteristic | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Rise time | $t_r$ | $V_{CC}$ = 10V, $I_C$ = 2mA<br>$R_L$ = 100Ω | — | 2 | — | μs |
| Fall time | $t_f$ | | — | 3 | — | |
| Turn−on time | $t_{ON}$ | | — | 3 | — | |
| Turn−off time | $t_{OFF}$ | | — | 3 | — | |
| Turn−on time | $t_{ON}$ | $R_L$ = 1.9 kΩ (Note 2)<br>$R_{BE}$ = OPEN<br>$V_{CC}$ = 5 V, $I_F$ = ±16mA | — | 2 | — | μs |
| Storage time | $t_S$ | | — | 15 | — | |
| Turn−off time | $t_{OFF}$ | | — | 25 | — | |
| Turn−on time | $t_{ON}$ | $R_L$ = 1.9kΩ (Note 2)<br>$R_{BE}$ = 220kΩ, $V_{CC}$ = 5 V<br>$I_F$ = ±16mA | — | 2 | — | μs |
| Storage time | $t_S$ | | — | 12 | — | |
| Turn−off time | $t_{OFF}$ | | — | 20 | — | |

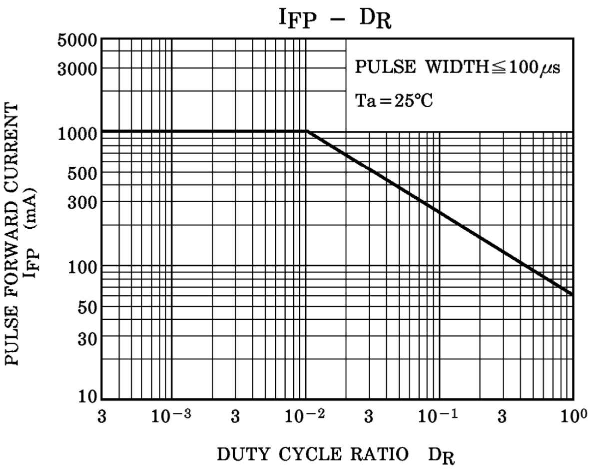
(Note 2) Switching time test circuit

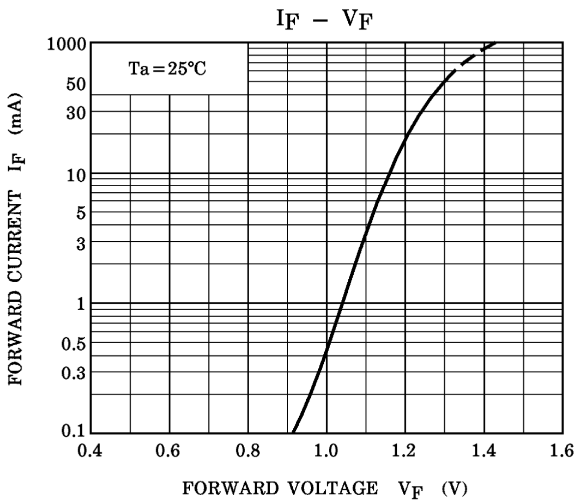


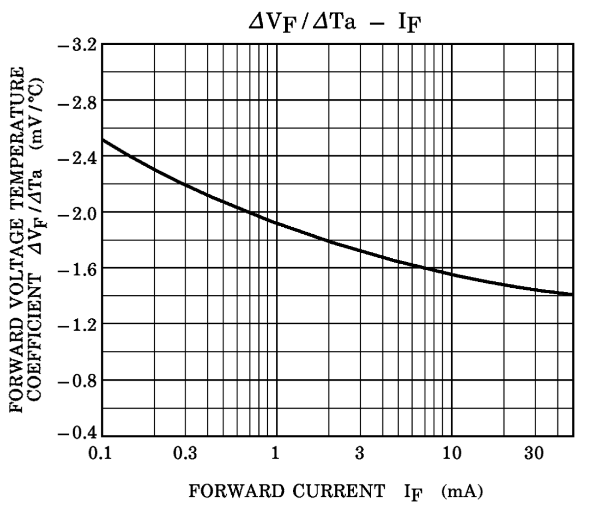



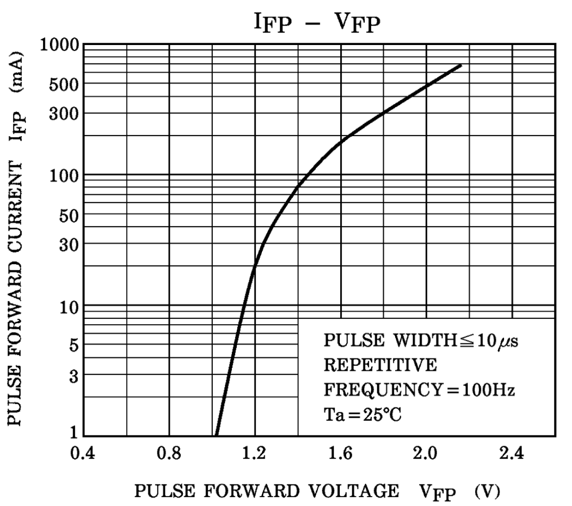

IF (RMS) – Ta
ALLOWABLE FORWARD CURRENT IF (RMS) (mA)
100
80
60
40
20
0
–20
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (°C)

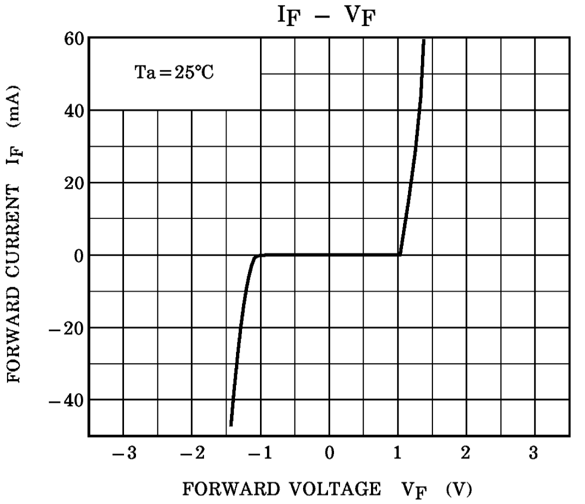

PC – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION PC (mW)
200
160
120
80
40
0
–20
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (°C)

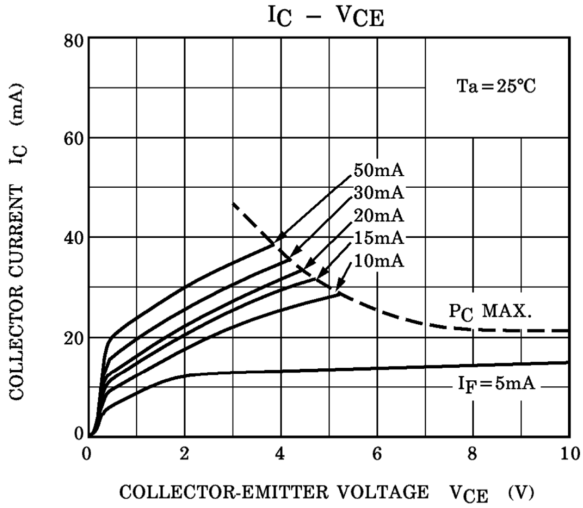

IFP – DR
PULSE WIDTH≦100μs
Ta = 25°C
PULSE FORWARD CURRENT IFP (mA)
5000
3000
1000
500
300
100
50
30
10
3
10⁻³
3
10⁻²
3
10⁻¹
3
10⁰
DUTY CYCLE RATIO DR

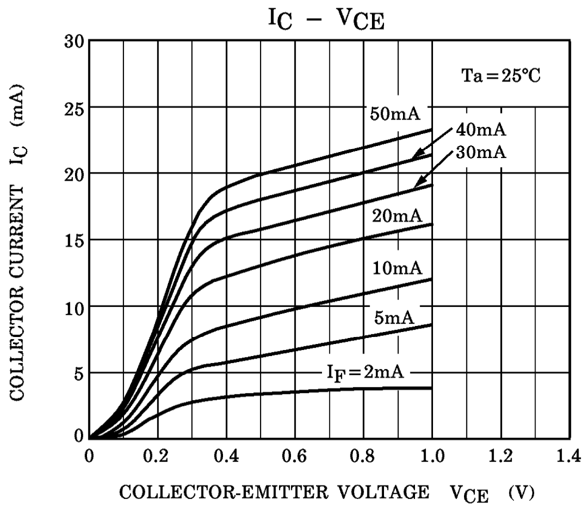

IF – VF
Ta = 25°C
FORWARD CURRENT IF (mA)
1000
50
30
10
5
3
1
0.5
0.3
0.1
0.4
0.6
0.8
1.0
1.2
1.4
1.6
FORWARD VOLTAGE VF (V)

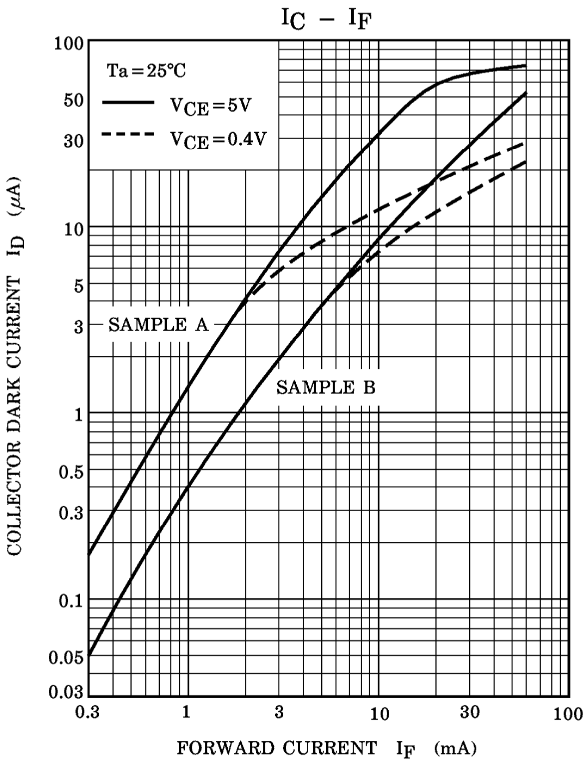

ΔVF / ΔTa – IF
FORWARD VOLTAGE TEMPERATURE COEFFICIENT ΔVF / ΔTa (mV / °C)
–3.2
–2.8
–2.4
–2.0
–1.6
–1.2
–0.8
–0.4
0.1
0.3
1
3
10
30
FORWARD CURRENT IF (mA)

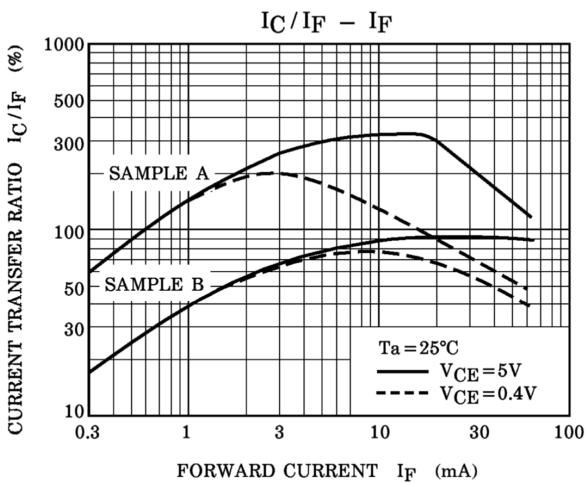

IFP – VFP
PULSE WIDTH≦10μs
REPETITIVE
FREQUENCY = 100Hz
Ta = 25°C
PULSE FORWARD CURRENT IFP (mA)
1000
500
300
100
50
30
10
5
3
1
0.4
0.8
1.2
1.6
2.0
2.4
PULSE FORWARD VOLTAGE VFP (V)

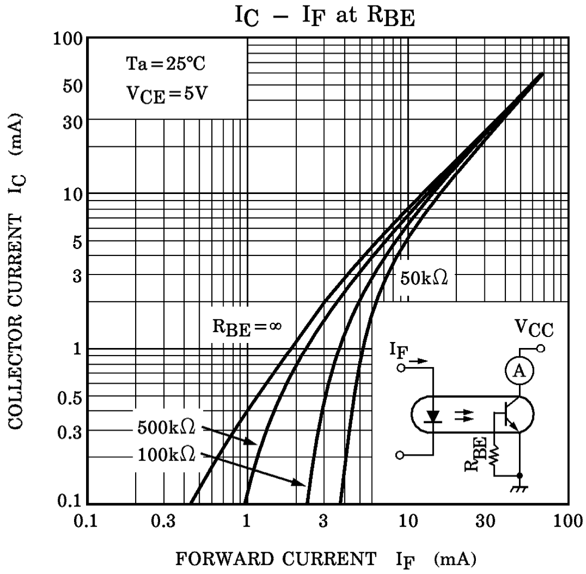

IF – VF
Ta = 25°C
FORWARD CURRENT IF (mA)
60
40
20
0
–20
–40
–3 –2 –1 0 1 2 3
FORWARD VOLTAGE VF (V)

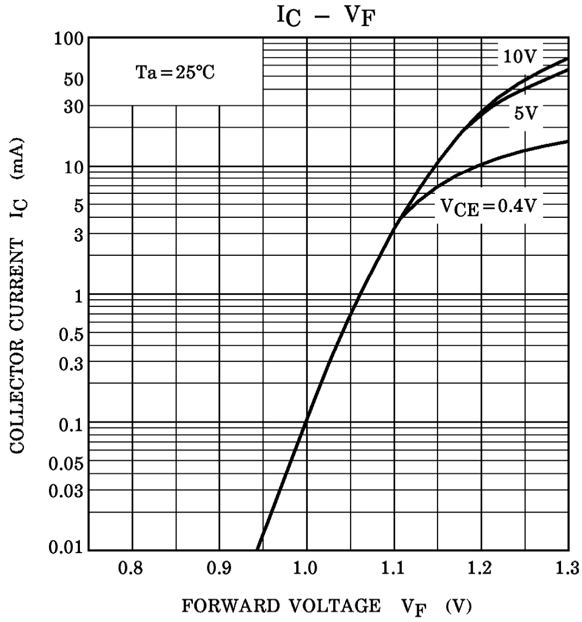

IC – VCE
Ta = 25°C
50mA
30mA
20mA
15mA
10mA
PC MAX.
IF = 5mA
COLLECTOR CURRENT IC (mA)
80
60
40
20
0
0 2 4 6 8 10
COLLECTOR-EMITTER VOLTAGE VCE (V)

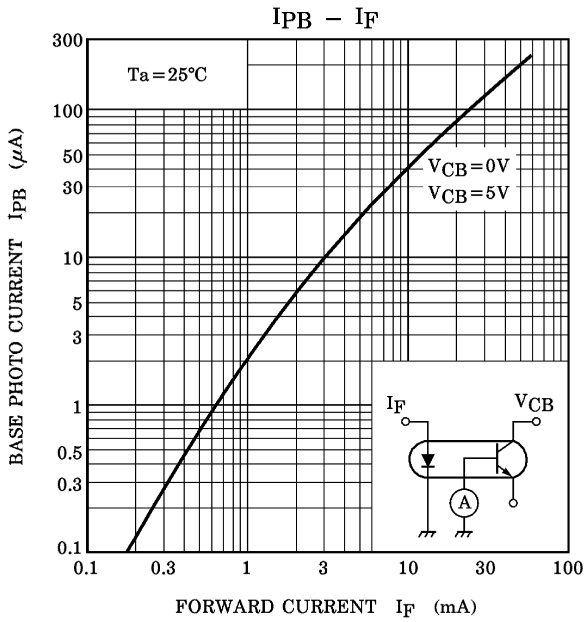

IC – VCE
Ta = 25°C
50mA
40mA
30mA
20mA
10mA
5mA
IF = 2mA
COLLECTOR CURRENT IC (mA)
30
25
20
15
10
5
0
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4
COLLECTOR-EMITTER VOLTAGE VCE (V)

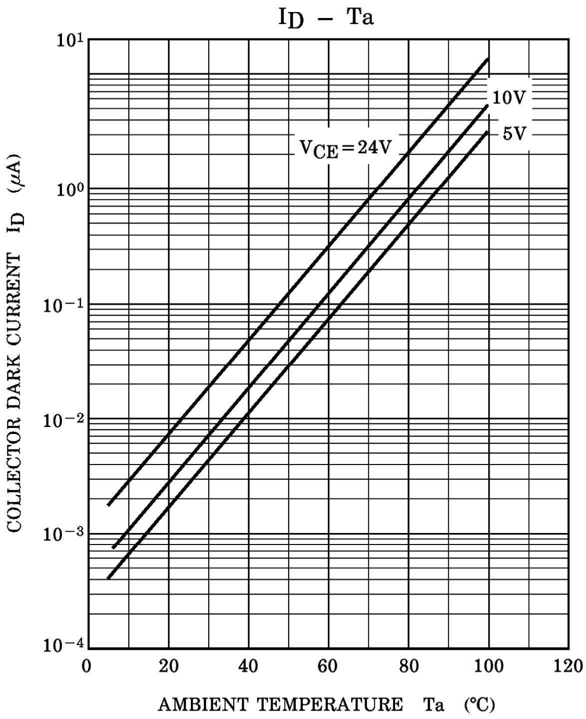

IC – IF
Ta = 25°C
VCE = 5V
VCE = 0.4V
SAMPLE A
SAMPLE B
COLLECTOR DARK CURRENT ID (μA)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.3 1 3 10 30 100
FORWARD CURRENT IF (mA)


IC / IF – IF
SAMPLE A
SAMPLE B
Ta = 25°C
VCE = 5V
VCE = 0.4V
CURRENT TRANSFER RATIO IC / IF (%)
1000
500
300
100
50
30
10
0.3 1 3 10 30 100
FORWARD CURRENT IF (mA)

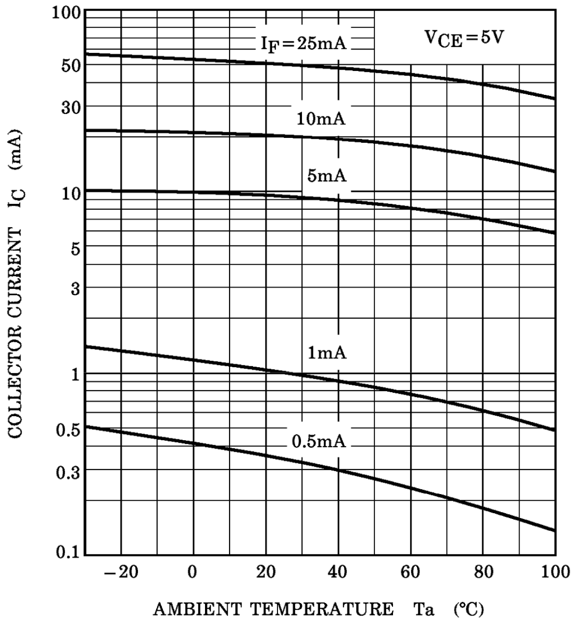

IC – IF at RBE
Ta = 25°C
VCE = 5V
RBE = ∞
500kΩ
100kΩ
50kΩ
IF
VCC
A
RBE
COLLECTOR CURRENT IC (mA)
FORWARD CURRENT IF (mA)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
30
100


IC – VF
Ta = 25°C
10V
5V
VCE = 0.4V
COLLECTOR CURRENT IC (mA)
FORWARD VOLTAGE VF (V)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
0.8
0.9
1.0
1.1
1.2
1.3

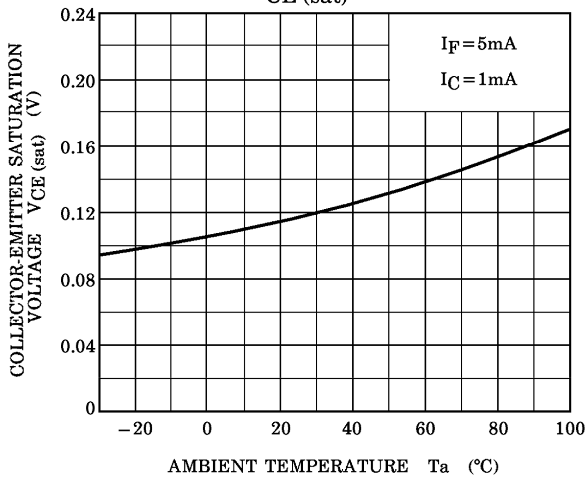

IPB – IF
Ta = 25°C
VCB = 0V
VCB = 5V
IF
VCB
A
BASE PHOTO CURRENT IPB (μA)
FORWARD CURRENT IF (mA)
300
100
50
30
10
5
3
1
0.5
0.3
0.1
0.1
0.3
1
3
10
30
100


ID – Ta
VCE = 24V
10V
5V
COLLECTOR DARK CURRENT ID (μA)
AMBIENT TEMPERATURE Ta (°C)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
10⁻⁴
0
20
40
60
80
100
120

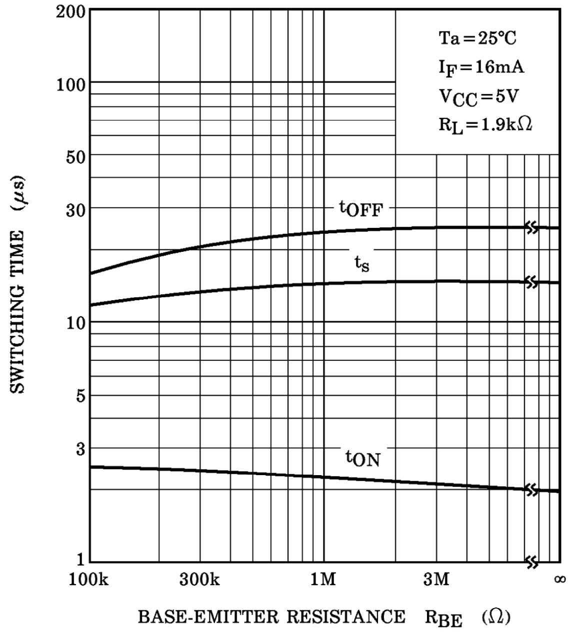
$I_C$ – Ta



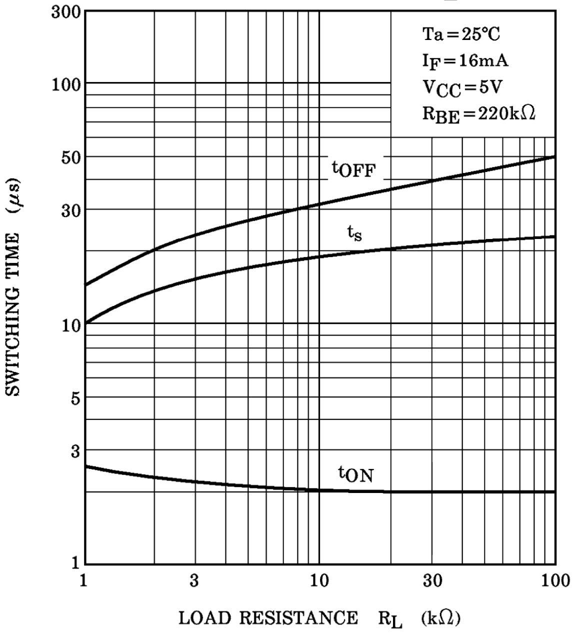

$V_{CE (sat)}$ – Ta

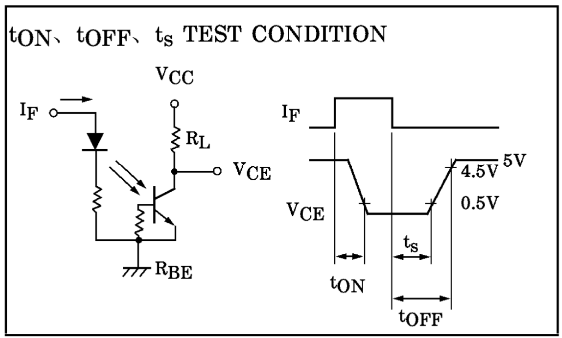



$R_{BE}$ – SWITCHING TIME




SWITCHING TIME – $R_L$



## RESTRICTIONS ON PRODUCT USE

20070701-EN

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